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SCHOOL OF EDUCATION
INDIANA UNIVERSITY

Studies in Secondary Education

by

Carl G. F. Franzen
Elvin S. Eyster
Nicholas A. Fattu
A. Pryce Noe
Frank L. Templeton

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A Study of the 1946-47 Enrollments in North Central Association High Schools in Indiana

by

CARL G. F. FRANZÉN

Professor of Secondary Education, Indiana University

THE necessity of having access to available data on enrollments in subjects taught in our secondary schools was acutely brought to my attention when I wrote a chapter on foreign languages for Harl R. Douglass' book, *The High School Curriculum*. An inquiry addressed to the U.S. Office of Education brought the response that it possessed no recent figures on enrollments and that it knew of very few such studies that had been made in recent years.

The North Central Association used to ask for a quinquennial report which included enrollment data from all member schools. The last such report came out in 1934-35, after which time, unfortunately, it was discontinued. I use the word "unfortunately," because I believe that a real educational purpose was served by these quinquennial reports. They made it possible to discover any trends that might reveal what was happening in the various subject fields. School people need to know the "signs of the times" in order to keep abreast of them. Is it not important, for example, to know what is happening in the field of mathematics with respect to remedial work, in the field of social studies with respect to courses in global understanding, in the field of foreign languages with respect to any one language, etc.? Such knowledge not only affects the vitalizing of the secondary curriculum, but it also influences the nature of the work in teacher preparation.

In order to learn what has been happening in the state of Indiana, enrollment studies in grades 9-12 in North Central Association schools were made in 1942-43 and 1946-47. The member schools were asked to send in class enrollments on their schedule of recitation sheets at the time their annual report blanks were due in the office of the State Chairman. The enrollment data were tabulated from these class schedule sheets, although the problem of interpreting the data was a most difficult one at times because of the cabalistic codes, signs, and abbreviations peculiar to each school system.

The present study is a detailed tabulation of the 1946-47 enrollment figures. Enrollments in the different subject fields are given in Tables I to XII.

It is somewhat difficult to discover just what is taught as English 12, because such work is elective in most high schools. Advanced grammar, dramatics, and debating may all be taught in the twelfth grade, but there is no assurance that such is the case. It was discovered that American literature was taught on both the eleventh and twelfth grade levels, although a much smaller number take it in the

TABLE I. ENROLLMENTS IN ENGLISH

Course	Boys	Girls	Total
English 9	11,915	11,707	23,622
English 10	12,060	13,369	25,429
English 11	8,691	9,078	17,769
English 12	3,158	3,729	6,887
Advanced Grammar	267	292	559
Journalism	505	868	1,373
Speech	1,909	2,132	4,041
Dramatics	229	541	770
Debating	69	65	134
Remedial English	540	407	947
Library Science	174	371	545
Bible	413	272	685
Radio	52	67	119
Miscellaneous	108	123	231
Total	40,090	43,021	83,111

twelfth grade. There is no excuse for the latter placement, since, if American history is taught on the eleventh grade level, as it should be, American literature should be placed there for the purposes of correlation.

Advanced grammar is taught only in schools of 500 enrollment and over. World literature is studied in only a few schools, with small enrollments. Remedial English is finding a place in schools of more than 200 students. Library science is most popular in the small schools. Debating is not a common course. Speech is increasing in popularity. Radio is found in larger schools only. Bible enrollments have decreased, and so have those in journalism.

TABLE II. ENROLLMENTS IN SOCIAL STUDIES

Course	Boys	Girls	Total
Grade 9	3,858	3,807	7,665
World History	5,746	5,519	11,265
American History	10,719	11,464	22,183
Government	6,436	7,069	13,505
Economics	701	788	1,489
Sociology	795	1,052	1,847
American Problems	975	1,300	2,275
Latin America	129	104	233
Pacific Relations	47	45	92
American Neighbors	30	29	59
International Relations	44	15	59
Elementary Geography	318	248	566
Advanced Geography	325	260	585
Medieval and Modern History	108	100	208
Miscellaneous	217	233	450
Total	30,448	32,033	62,481

The amazing revelation in the social studies area is the seemingly small number of students enrolled in any ninth grade courses. Only one third of the total ninth grade enrollment is included in the report.

Fifty per cent of the tenth graders are taking World History. Since practically all eleventh graders are enrolled in American History and all seniors are taking courses in government and advanced social studies, it might be well worth-while to make World History a two-year course, beginning in the ninth grade.

The World War is responsible for such courses as Pacific Relations, International Relations, Latin America, and American Neighbors, although the enrollments are very small. Medieval and Modern History is passing out of the curricular picture. In spite of the emphasis on a global world, the enrollments in geography are decreasing.

TABLE III. ENROLLMENTS IN MATHEMATICS

Course	Boys	Girls	Total
Arithmetic 9	1,814	1,965	3,779
General Mathematics	3,194	2,828	6,022
Algebra	8,579	7,721	16,300
Advanced Algebra	3,082	1,057	4,139
Geometry	6,602	4,717	11,319
Solid Geometry	1,008	149	1,157
Trigonometry	686	134	820
Advanced Mathematics	347	283	630
College Mathematics	235	33	268
Remedial Mathematics	234	220	454
Refresher Mathematics	313	436	749
Miscellaneous	81	28	109
Total	26,175	19,571	45,746

More students are enrolled in ninth grade mathematics courses than there are students in the ninth grade, if the reported data are accurate. Is it possible that there are as many as 9 per cent who are repeaters? If such is the case, schools need to give themselves a thorough examination as to the causes for such a failure. In line with

TABLE IV. ENROLLMENTS IN SCIENCE

Course	Boys	Girls	Total
General Science	33	0	33
Biology	8,656	10,455	19,111
Botany	462	649	1,111
Zoology	207	231	438
Physical Geography	297	259	556
Physics	4,381	1,000	5,381
Industrial Physics	151	13	164
Household Physics	0	19	19
Aeronautics	185	17	202
Radio	58	0	58
Photography	36	32	68
Chemistry	3,911	2,702	6,613
Physiology	340	293	633
Advanced Physical Science	748	209	957
Household Science	0	59	59
Psychology	38	58	96
Total	19,503	15,996	35,499

this situation, we note pitifully small enrollments in Remedial and Refresher Mathematics courses. If more of the latter type of work were carried on, it might be possible to improve what is otherwise a deplorable state of affairs. A partial explanation may be found in the excessively large numbers enrolled in first-year algebra, 80 per cent in Group I schools, 75 per cent in Group II schools, 70 per cent in Group III schools, and 69 per cent in Group IV schools.

A sizable number, about 40 per cent of the tenth graders, are enrolled in plane geometry, and close to 7,000 are enrolled in advanced mathematics courses. In the latter group, with the exception of advanced mathematics, the boys far exceed the girls in number.

As is to be expected, General Science is not considered a senior high school subject in Indiana. Biology is *the* science studied by most high school students, the enrollment being greater than in all the other science courses combined. Botany and Zoology are still taught in a few schools as separate subjects, but both are declining in enrollments, especially Zoology.

Chemistry attracts more students, especially girls, than do the various courses in Physics. Aeronautics and Radio are products of the war influence.

In spite of the talk in educational circles about offering Physical Science as a course in all senior high schools and to all students whose science equipment would be limited by taking only Physics or Chemistry, the present enrollment in this new area, a mere 1,000, is lamentably

TABLE V. ENROLLMENTS IN FOREIGN LANGUAGES

Course	Boys	Girls	Total
LATIN			
I	3,130	4,172	7,302
II	1,914	2,702	4,616
III	255	380	635
IV	113	111	224
Total	5,412	7,365	12,777
SPANISH			
I	2,142	2,577	4,719
II	1,124	1,538	2,662
III	134	181	315
IV	25	44	69
Total	3,425	4,340	7,765
FRENCH			
I	327	583	910
II	156	305	461
III	55	54	109
IV	14	0	14
Total	552	942	1,494
GERMAN			
I	266	122	388
II	111	75	186
III	10	6	16
Total	387	203	590
GREEK			
I	33	10	43
II	29	27	56
Total	62	37	99
Total	**9,838**	**12,887**	**22,725**

small. Nevertheless, it is a hopeful sign to note that the enrollment is actually increasing.

Physical Geography, as a science, and Physiology are definitely decreasing in student enrollments.

Latin continues to hold its own in Indiana, with an enrollment which, although decreasing from year to year, is still greater than the combined enrollments in all the other foreign languages. Spanish is the foreign language in which enrollment is increasing. It has far outstripped French. In fact, the position of the two languages has been absolutely reversed within the past twelve years. German is taught in a few scattered schools. It has never recovered from the blow struck it during the first World War.

One very noticeable factor in the foreign language area is the small number of students who continue into the third and fourth years. In Latin, 94 per cent of the enrollments are in the first two years; in Spanish, 95 per cent; in French, 92 per cent; in German, 97 per cent; and in Greek, 100 per cent. These percentages signify that foreign languages in the North Central Association high schools in Indiana are definitely two-year subjects and that those who claim any values that accrue from a study of foreign languages must see that these values are taught during the first two years.

Another item of interest is that, with the exception of German and Greek, the ratio of boys to girls is about 3 to 4.

TABLE VI. ENROLLMENTS IN BUSINESS EDUCATION

Course	Boys	Girls	Total
Beginning Typing	3,296	10,056	13,352
Advanced Typing	924	3,058	3,982
Beginning Stenography	183	5,232	5,415
Advanced Stenography	58	2,101	2,159
Transcription	3	175	178
Beginning Bookkeeping	1,355	4,494	5,849
Advanced Bookkeeping	116	329	445
Commercial Arithmetic	1,263	2,343	3,606
Commercial Geography	163	162	325
Commercial Law	228	438	666
Junior Business	1,631	4,580	6,211
Business English	147	778	925
Office Practice	48	996	1,044
Machine Calculation	18	266	284
Salesmanship	198	523	721
Retail Problems	51	67	118
Merchandising	35	110	145
Consumer Education	59	79	138
Miscellaneous	16	27	43
Total	9,792	35,814	45,606

The first noticeable fact about the above figures is that three and a half times as many girls as boys are enrolled. This is especially true in stenography, in which area there has evidently been some rather poor or unsuccessful counseling, inasmuch as the opportunities for boys to make good in the secretarial field are considered most excellent.

The largest enrollments are in the Beginning Typing and Bookkeeping classes. Many of the students taking Advanced Typing may be the same as those taking Advanced Stenography, but there is still evidence that Advanced Stenography is not achieving the attention it merits, unless too many are admitted to the beginning class who should not have been allowed to enroll in the first place. There is more reason for taking this advanced course than there is for taking Advanced Typing, because one year of stenography seldom produces enough proficiency on the part of the learner. Furthermore, the advanced course provides for transcription.

It is gratifying to note the 6,000 enrollments in Junior Business courses. Consumer Education is attracting a little attention, but not much. Courses in Distributive Education are offered in the large school, but the enrollments are small.

TABLE VII. ENROLLMENTS IN ARTS AND CRAFTS

Course	Boys	Girls	Total
Beginning Art	1,912	2,761	4,673
Beginning Arts and Crafts	547	682	1,229
Beginning Commercial Art	156	223	379
Advanced Arts	610	1,081	1,691
Advanced Arts and Crafts	105	258	363
Advanced Commercial Art	41	87	128
Art Appreciation	104	138	242
Miscellaneous	18	49	67
Total	3,493	5,279	8,772

Over 6,000 students are enrolled in Beginning Art classes of one sort or another, with 60 per cent of them being girls. It is gratifying to note that "Arts and Crafts," a designation that shows a most desirable trend, is being listed as a special type of art class. Only about a third of the beginners continue into advanced classes. These, undoubtedly, are students who have discovered a talent or special interest in some art activity.

Music continues to show a steady interest on the part of boys and girls, with 50 per cent of the total enrollment in some form of vocal activity and 40 per cent in instrumental courses. There are, of course, duplications of enrollment in band and orchestra, and in instrumental and vocal classes. Theory and appreciation classes continue to be small. In vocal groups girls outnumber the boys more than 2 to 1, but in instrumental groups the two sexes are evenly distributed.

"Physical Fitness" is probably used to describe the work taken by juniors and seniors, because many schools have gone back to the requirement of only two years in Physical Education. It seems that 65 per cent of our boys and girls are engaged in some sort of physical activity. Some 14,000 are enrolled in health and/or safety classes, with over three times as many students in separate courses as in the

TABLE VIII. ENROLLMENTS IN MUSIC

Course	Boys	Girls	Total
Appreciation	822	1,022	1,844
Advanced Appreciation	13	29	42
Harmony	105	130	235
History of Music	4	4	8
Vocal Music			
Beginning Chorus	1,804	4,916	6,720
Advanced Chorus	277	694	971
Choir	465	1,079	1,544
Glee Club	953	2,136	3,089
A Cappella Choir	59	146	205
Miscellaneous Vocal	1,262	1,326	2,588
Total	4,820	10,297	15,117
Instrumental Music			
Beginning Band	2,773	2,285	5,058
Advanced Band	1,384	1,330	2,714
Concert Band	340	251	591
Dance Band	26	2	28
Beginning Orchestra	654	1,032	1,686
Advanced Orchestra	229	382	611
Miscellaneous Instrumental	680	813	1,493
Total	6,086	6,095	12,181
Miscellaneous	65	243	308
Total	11,915	17,820	29,735

combined course. The question may well be raised as to the advisability of the separate courses on the grounds that the content will have to be spread pretty thin in order to take up the time.

TABLE IX. ENROLLMENTS IN HEALTH AND PHYSICAL EDUCATION

Course	Boys	Girls	Total
Physical Education	27,381	28,155	55,536
Physical Fitness	2,378	1,718	4,096
Health and Safety			
Senior Health and Safety	1,713	1,636	3,349
Health	5,146	3,298	8,444
Safety	1,353	1,077	2,430
Total	8,212	6,011	14,223
Hygiene	0	57	57
First Aid	93	93	186
R. O. T. C.	1,176	0	1,176
Miscellaneous	282	311	593
Total	39,522	36,345	75,867

TABLE X. ENROLLMENTS IN HOUSEHOLD ARTS

Course	Boys	Girls	Total
Home Economics 9-10	19	3,964	3,983
Home Economics 11-12	12	1,497	1,509
Foods	113	3,567	3,680
Advanced Foods	62	924	986
Clothing	2	3,423	3,425
Advanced Clothing	0	2,134	2,134
Home Management	0	579	579
Home Making	0	479	479
Family Relations	113	268	381
Social Practice	0	329	329
Child Care	0	85	85
Home Nursing	0	895	895
Related Arts	25	118	143
Miscellaneous	108	315	423
Total	454	18,577	19,031

It is difficult to analyze the above courses for comparative purposes, because the courses listed just as Home Economics may be any of the other courses. And, then, when the course is mentioned, it is difficult to know on which grade level to place it. Consequently, accurate analyses cannot be given. It is obvious, however, that Foods and Clothing are still the main standbys in this area. It seems that the courses are not sufficiently interesting or worth-while, because

TABLE XI. ENROLLMENTS IN INDUSTRIAL ARTS

Course	Boys	Girls	Total
General Shop	4,875	54	4,929
Shop 10	1,317	31	3,148
Shop 11	782	15	797
Shop 12	479	10	489
Mechanical Drawing	5,383	69	5,452
Advanced Mechanical Drawing	1,152	6	1,158
Architectural Drawing	150	3	153
Drafting	1,095	4	1,099
Woodwork	2,455	12	2,467
Advanced Woodwork	961	0	961
Machine Shop	2,482	6	2,488
Advanced Machine Shop	1,027	0	1,027
Metal Work	1,567	18	1,585
Printing	1,388	99	1,487
Advanced Printing	182	7	189
Electrical Work	837	13	850
Auto Mechanics	1,332	0	1,332
Blueprint Reading	111	1	112
Pattern Making	222	0	222
Foundry	452	7	459
Shop Mathematics	1,198	0	1,198
Related Science and Mathematics	211	0	211
Vocations	530	14	544
Miscellaneous	413	26	436
Total	30,601	395	30,996

less than half of the girls continue into the advanced classes, especially in the case of Foods. Although the total number of boys enrolled is small, it is significant to know that over a hundred are enrolled in Foods and in Family Relations. We need much more attention paid to the second of these courses.

Drafting of one sort or another accounts for 25 per cent of the enrollments in the industrial arts area and leads all the other types of courses. General Shop means, in most cases, a non-vocational, exploratory experience. More boys should be enrolled in it as part of the work experience of which we hear so much these days.

Just as in the case of household arts, it is difficult to analyze Woodwork, Metal Work, and Machine Shop from the enrollments reported for grades 10, 11, and 12, and therefore an accurate report cannot be presented here. It is a good guess, however, to say that Woodwork has the largest enrollment next to Drawing and is followed by Machine Shop.

The most interesting feature about this area is that, as in household arts, the opposite sex from the one normally taking the course is in evidence. In only six of the courses listed are there no girls. The number of girls enrolled range from 1 to 99, with the larger enrollments in Drawing, Printing, and General Shop. The influence of the war, when so many girls worked in factories, is probably responsible for this situation.

TABLE XII. ENROLLMENTS IN AGRICULTURE

Course	Boys	Girls	Total
Agriculture 9-10	1,539	2	1,541
Agriculture 11-12	989	0	989
Agricultural Biology	44	1	45
Farm Shop	116	0	116
Farm Management	55	0	55
Miscellaneous	125	0	125
Total	2,868	3	2,871

Agriculture plays an insignificant role in the curricula of North Central Association secondary schools in Indiana. Even in the small high schools, most of which are located in agricultural areas, only approximately 15 per cent of the students are enrolled. One of the most important courses in agriculture is Farm Shop, a course which ought to serve the functions of a general shop in rural areas, because there is no other way for boys, as well as girls, to learn unspecialized practical activities. And yet the number of boys listed in this course is almost negligible, about 4 per cent of the total enrollment. A suggestion has been made that Farm Shop work be included as a part of the regular courses in agriculture. The objection to this method is that the other boys in school are thereby deprived of the opportunity to take any such work.

TABLE XIII. ENROLLMENT DATA REPORTED FOR GRADES 9-12 FOR 1946-47 AS COMPARED WITH THE DATA FOR 1934-35 AND 1942-43

Subject	1934-35 (120 schools)		1942-43 (154 schools)		1946-47 (162 schools)	
	Number of Pupils	Per Cent of Pupils	Number of Pupils	Per Cent of Pupils	Number of Pupils	Per Cent of Pupils
English	79,545	95	86,642	91	83,111	90
Social Studies	62,457	74	66,681	70	62,481	67
Foreign Languages	29,613	35	22,722	24	22,626	24
Latin	17,497	21	13,537	14	12,777	14
Spanish	3,210	4	6,575	7	7,765	8
French	6,823	8	1,950	2	1,494	2
German	2,083	3	660	1	590	1
Mathematics	42,140	50	44,772	47	45,746	49
Science	33,720	40	37,632	39	35,499	38
Health and Physical Education	45,278	45	73,454	77	75,867	81
Business	48,315	52	53,555	56	45,606	49
Arts and Crafts	7,037	8	8,540	9	8,772	9
Music	26,115	31	26,298	27	29,735	31
Household Arts	16,057	19	20,144	21	19,031	20
Industrial Arts	23,244	27	32,121	33	30,996	32
Agriculture	1,611	2	3,030	3	2,871	3
Total	84,320	100	95,740	100	93,259	100

The preceding analyses for the separate subject areas have revealed the relationship within each area. Table XIII gives the total enrollments in each area for three periods, 1934-35, 1942-43, and 1946-47. In order that comparisons might be made on a comparable basis and that major trends might be discovered, all the area enrollments have been reduced to percentages of the school population for each of the three years.

We find that there has been a 5 per cent decrease in enrollments in English over the 12-year period. There is a 7 per cent drop in social studies, and an 11 per cent drop in foreign languages. There are slight decreases in the fields of science and business. Enrollments in mathematics, arts and crafts, music, household arts, and agriculture have remained about the same. In health and physical education there has been an increase of 27 per cent and in industrial arts, one of 5 per cent.

In the area of foreign languages, Latin enrollments have decreased 11 per cent, with an actual numerical decrease of 7,000 enrollments. Spanish and French have exactly reversed their positions.

With all the furor over mathematics during the war, it is surprising to note a 1 per cent decrease in the 12-year period, although there is a gain of 2 per cent within the last four years. When work

in remedial and consumer mathematics is established on a firmer level, it may be that the outlook here will be a little brighter.

Those who are interested in enrollment analyses will find further opportunity to make interpretations of their own concerning data given in any or all of the tables presented in this study. Only the highlights, so to speak, have been discussed in this study. It is our hope to make a similar analysis for the year 1947-48.

Guidance Service for Pupils Electing Shorthand

by

ELVIN S. EYSTER
Professor of Business Education, Indiana University

THIS report includes a brief account of (1) a five-year study of the achievement of pupils who elected shorthand, and (2) the results of a guidance service to pupils who elected shorthand in the succeeding five-year period. The study was conducted at North Side High School, Fort Wayne, Indiana, from 1927-28 to 1938-39, inclusive.

Among the conditions that prompted the study were the following: (1) the number of pupils beginning the study of shorthand (in Fort Wayne) annually in all of the high schools and business colleges combined was approximately 1,000 persons, whereas the need for additional stenographers and replacement of those who left the occupation was less than 200 annually; (2) a large percentage of the pupils who completed the shorthand training program in the school were employed in office or other jobs where shorthand was not used; and (3) in spite of a very high percentage of failure in shorthand as compared to failure in other subjects, the occupational competency of the pupils after completing the shorthand program was not as high as desirable.

The attempt to attain occupational competency in the shorthand classes resulted not only in high failure but also in discouragement of the pupils. There were indications that some pupils were enrolling in shorthand who would experience great difficulty in mastering the subject and attaining occupational competency in the usual period of four semesters of instruction. As a result of the foregoing situations and conditions, the study was undertaken to determine the degree of accuracy with which achievement in shorthand might be predicted by an analysis of several selected factors. More than 1,000 pupils were included in the study.

The factors used in making the prognosis were:

1. Mental ability
   Mental test scores were provided by the Bureau of Research of the city schools
2. Average mark in English composition
3. Average high school grade, excluding English
   The average of grades in all full-time high school subjects was computed.
4. Special aptitude for shorthand
   Hoke's Prognostic Test of Stenographic Ability was administered to all pupils who elected shorthand
5. Personal trait ratings
   Subjective trait ratings on:
   (a) Accuracy and neatness
   (b) Initiative and self-confidence

(c) Responsibleness
(d) Dependability
(e) Courteousness and refinement
(f) Interest and industriousness
(g) Tact and graciousness
(h) Pleasantness and cheerfulness
(i) Appearance and grooming
(j) Trustworthiness and honesty

The trait ratings were the composite of the ratings for each semester the pupil had been in high school. Prior to 1936-37, the ratings were made by the business teachers under whom the pupil was enrolled; after 1936-37, the ratings used were a composite of the ratings made by the teachers of all full-time subjects.

Names of Pupils	Mental Ability[1]	Average English Grade	Average of all high school grades, not including English	Aptitude Test[2]	Personal Trait Rating[3]	Prognosis[4]	Mid-semester Grade in Shorthand	Final (term) Grade in Shorthand
Cook, Linna	C	C-	C-	16	5-2-3	NA		
Colman, Bessie	B	B	B	54	2-1-1	A		
Davis, Dorothy	D	B-	C	13	4-3-3	NA		
Harford, Joan	C	B	B-	29	3-3-3	W		
Hobbs, Gertrude	A	B-	B-	94	2-1-2	A		
Kessler, Edna	B-	C-	C-	16	3-4-4	NA		
Landin, John	B	A-	A-	97	1-1-1	A		
Siples, LaVon	B	C	C	96	3-2-3	W		
Smith, Harvey	C-	C-	C-	48	2-1-1	W		

[1]Mark interpretation -- A, 90-100%; B, 80-89; C, 70-79; D, below 70.

[2]Boke's test scores -- Raw scores have been converted to percentile scores.

[3]Trait rating interpretation -- 1, far above average; 2, above average; 3, average; 4, below average; 5, far below average. The first digit is the composite average on work-habit traits (accuracy and neatness, and initiative and self-confidence); the second digit is the composite average on character traits (responsibleness, dependability, trustworthiness and honesty, and interest and industriousness); and the third digit is the composite average on personality traits (courteousness and refinement, tact and graciousness, pleasantness and cheerfulness, and appearance and grooming).

[4]Prognosis symbols -- A, approved; W, warned (50-50 chance); and NA, not advisable.

During the first five years of the study, the head of the business department collected the data on the five factors listed above for each pupil who had elected shorthand. A work sheet similar to Figure 1 was used for recording the data and making the prognosis. The data for each pupil were carefully studied and an estimate of the pupil's chances of success in shorthand was recorded. Pupils were classified into three groups: (1) those who should experience no difficulty in shorthand, marked on the work sheet as A (approved); (2) those who probably had a 50-50 chance of success, marked on the work sheet as W (to be warned); and (3) those for whom there was little, if any, favorable indication of success in shorthand, marked on the work sheet as NA (not advisable).

A comparison of the prognosis with the grades earned in shorthand for the first five-year period is given in Table I. Neither the teachers of shorthand classes nor the pupils knew that the prognosis was being made.

TABLE I. SHORTHAND ACHIEVEMENT COMPARED WITH PROGNOSIS OF ACHIEVEMENT IN SHORTHAND BEFORE COUNSELING SERVICE WAS GIVEN TO PUPILS ELECTING SHORTHAND

Prognosis	Number Electing Shorthand	Shorthand Achievement										Left School	Per Cent of Failure
		A+	A	A−	B+	B	B−	C+	C	C−	F*		
Approved	370	2	18	26	41	49	44	57	56	60	9	8	2.4
50-50 chance ..	138			1	5	4	10	13	15	17	68	5	49.2
Not advisable ..	109										102	7	100.0
Total	617	2	18	27	46	53	54	70	71	77	179	20	29.0

* Pupils withdrawing and remaining in school are included in the failures.

At the end of the five-year study, certain observations were made and conclusions drawn:

1. The prognosis was highly accurate in all three categories—approved, 50-50 chance, and not advisable.

2. There was relatively close relationship between the scores on Hoke's prognostic test and mental ability, and fairly close relationship with average high school marks. Used as a single factor, the score on Hoke's test was practically useless as the basis for prognosis. Since it had a close relationship to two other factors, it was valueless in the prognosis.

The other four factors, taken singly and in combination, were related to achievement in shorthand.

It is doubtful that any of these four factors measure aptitude for shorthand; it is probable that, even though singly and collectively they are related to achievement in shorthand, they measure general scholastic ability rather than special abiliy to master shorthand.

3. No claim is made as to the scientific accuracy of prediction. While simple and multiple correlations were calculated and regression equations were computed, no attempt was made to reduce the prognosis to a mathematical or statistical formula.

4. Since such a high degree of accuracy was attained in the prognosis, it was decided that it would be feasible and desirable to use the five factors as a basis for counseling pupils who had elected shorthand.

Beginning in 1932-33, after the data had been collected on a work sheet similar to Figure 1, the pupils who had elected shorthand for the next semester were counseled. An attempt was made to help the pupil analyze and interpret his own abilities as indicated by the

five factors in the light of the probable difficulty he would experience in achieving occupational competency in shorthand. No effort was spared in assisting the pupil to understand his own situation. Interest in and need for shorthand as an occupational tool—two factors not included in the prognostic data—were always weighted heavily in the counseling. No attempt was made to influence the pupil's decision; no pupil was told he could not take shorthand. The emphasis in counseling was wholly on developing an understanding of the factors and good judgment in making the decision.

As in the preceding five-year period, teachers did not have access to the prognosis. Achievement standards in the shorthand classes were increased materially in the second five-year period as compared to those in the first five-year period.

A comparison of the prognosis and the achievement in shorthand during the period when counseling service was given is shown in Table II.

TABLE II. SHORTHAND ACHIEVEMENT COMPARED WITH PROGNOSIS OF ACHIEVEMENT IN SHORTHAND WHEN COUNSELING SERVICE WAS GIVEN TO PUPILS ELECTING SHORTHAND

Prognosis	Number Electing Shorthand	Number Not Taking Shorthand After Conference	Number Taking Shorthand	Shorthand Achievement										Left School	Per Cent of Failure
				A+	A	A−	B+	B	B−	C+	C	C−	F*		
Approved	212	6	206	1	11	15	21	29	32	31	34	23	3	6	1.5
50-50 chance	103	62	41						1	2	5	9	20	4	48.8
Not advisable	108	102	6										5	1	100.0
Total	423	170	253	1	11	15	21	29	33	33	39	32	28	11	11.1

* Pupils withdrawing and remaining in school are included in the failures.

The following observations and conclusions were made:

1. Even though the enrollment of the school more than doubled during the period covered by this entire study, the enrollment in shorthand decreased approximately one third after counseling and guidance service was given.

2. Failure dropped from 29.0 per cent to 11.1 per cent. The level of achievement in shorthand classes increased greatly.

3. The idea that shorthand was a subject that requires studious application and diligence on the part of the pupil spread rapidly. Undoubtedly, many competent pupils who would like to have had it did not elect shorthand because they were fearful their scholastic record might be jeopardized.

4. The prognosis as to success in shorthand seemed to apply to other high school subjects with approximately the same degree of accuracy as it did to shorthand. This statement is based upon the results of a related, but limited, study of the comparison of the prognosis in shorthand to the achievement of the same pupils in such subject areas as language, science, and advanced mathematics.

5. From the foregoing observation, it is concluded that the five factors, both singly and collectively, measure general scholastic ability rather than special aptitude for shorthand.

6. Counseling is the heart of the entire procedure used. The data on the five factors merely provide a point of departure and a basis for the counseling.

7. The reaction of pupils and parents to a guidance procedure such as is described herein is dependent upon the carefulness with which the plan is administered and the skill with which the counseling is done.

Some Relationships Between Indices of School Adequacy and Certain Measures of Pupil Achievement

by

NICHOLAS A. FATTU
Assistant Professor of Education, Indiana University

Introduction

IT is the purpose of this study to investigate the relationship between certain measures of school adequacy and pupil scores on selected measures of pupil achievement. A more popular phrasing of the title might be "Do good schools pay?" Research on this problem, which has been of vital concern to educationists for a long time, shows a surprising diffusion of energy. A systematic search of the literature reveals no comprehensive research attempting to study the problem directly. Many branches of investigation which tended to circumscribe the problem were found—studies which compare performane of military inductees on common tests with the type of school support current in their home community; studies concerned with certain facets of school support, federal and state aid or equalization; discussions of the economic values of education; studies concerned with the effects of schooling on intelligence and other test scores. While all of these studies touched some important areas of school management, there were none directly concerned with the problem of school adequacy in relation to pupil performance.

Data for the present study were collected in the University High School at Bloomington. Pupils enter from rural schools in the county at the ninth grade level. These rural schools exhibit a tremendous variation in both school support and school adequacy—a range so great that probably few counties in this country can equal it.

Here, then, was an opportunity to observe the relation between test performance and indices of school adequacy where the range of school adequacy was not unduly restricted by local conditions.

Data for the present study were collected from two entering classes and these data were concerned only with the pupils at the time they graduated from the eighth grade. Because of the limited time it has been under way, the present investigation is in the nature of a survey of the problem rather than a complete study. A complete study will not be published until more classes have been studied and some individuals have been followed throughout their high school careers. The present study concerns itself with (1) a review of related literature; (2) a discussion of the measures of school adequacy and the manner in which numerical scores were derived; (3) a brief summary of the relation of these numerical adequacy indices of school adequacy to scores on the California Test of Mental Maturity, Otis Self-Administering Group Intelligence Test, Iowa Silent Reading Test, Cooperative English Test C-1, and Cooperative Arithmetic Test.

Review of Related Studies

Since studies bearing directly upon a topic were not available, it was necessary to resort to a review of certain related studies in order to discover possible implications and leads for the present investigation. Related studies summarized below do not, by any means, exhaust the list of studies made on these topics. They are, rather, a representative list of the better ones, and are classified under the following rubrics:

1. Studies relating school support to military test scores or level of school functioning.
2. Studies of facilities and support—those concerned directly with school support, and those concerned with equalization.
3. Studies of the economic values of education.
4. Studies of teaching and learning atmosphere—effects of schooling on intelligence and other test scores.

Studies Relating School Support to Measures of Learning. Bagley's (2)[1] pioneer study found that the average correlation of state school support indices with performance on the Army Alpha Intelligence Test was 0.66. Davenport and Remmers (12) essentially repeated the Bagley study with World War II scores on the Army-Navy Qualifying Test, and found a correlation of 0.80 with current pupil cost. Vincent (51) and the Educational Conference Board of New York State (15) also showed that desirable practices in schools correlated substantially with the level of school support.

Implications of studies mentioned in this section may possibly be summarized in Bagley's words (2): "Results of these tests tell us convincingly . . . that where schools have been neglected, there is relative weakness; where schools have been cherished there is relative strength."

Educational Support. Most of the studies of educational support seemed to be based upon deductive argument rather than upon collection of pertinent data. Harris (22), Borzelle (4), Miller (33), and Vincent (51) indicated that the financial rewards were insufficient to attract good students into teaching. The teacher shortage, in their opinion, was due to exploitation of teachers, low salaries, and the consequent lack of esteem of teachers in the community. Kandel (29:214) cited a French and a British report, both of which agreed that parents may have high esteem for some teachers but they have not learned to esteem the profession as a whole very highly because "prestige is closely connected with financial status."

Burke (7) discussed certain facts on pupil costs, average salaries, and pupil-teacher ratio and showed that New York State, outside of New York City, was not as favorably placed as the average figures seem to indicate. Woods (55) ranked the 48 states on the need for education, ability to pay for education, efforts of the states to provide schools, and the holding power of the high school.

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[1] Numbers in parentheses refer to references in the bibliography, on pages 29 to 32.

The discussion by Kandel (29) summarized the general tone of studies mentioned in this section. He indicated that the American public has long cherished a deep faith in education, but it has not been as ready to contribute to the dignity of education by rewarding teachers commensurate with that faith and dignity.

Equalization. Equalization of educational opportunity by federal and/or state support was discussed by Norton (40), Boushall (5), Norton and Norton (43), Edwards (18), Norton and Lawler (41, 42), and the Educational Policies Commission (16). All agreed on the need for such support. There was some disagreement on the question of whether funds could be provided without bringing in outside undesirable controls. A comprehensive survey of the recent literature and a bibliography was given by Morphet and Johns (35).

One of the dissenting voices was that of Grieder (20), who argued that equalizing financial support by outside means would not equalize educational opportunities because of difference in community resources. He believed that equalization might mean "leveling down" as well as "leveling up." Pessimism in a similar vein was expressed by Hunt (26). These writers would have the state set up a minimum or foundation program rather than an equalization program. One gathers the impression that difference among these writers is largely one of words rather than of proposed actions.

Economic Values of Education. A good deal of the recent discussion on teacher salaries was concerned with the economic value of education. The U.S. Chamber of Commerce, Committee on Education (50), emphasized the direct relationship between educational level and the economic status of our people. Evidence was presented to show that added education increased the productive and consuming capacity of people; that such factors as income, level of per capita sales, rent paid for homes, purchase of printed matter, and possession of modern conveniences "reflect a measure of material well-being in direct ratio to the level of education" (50:3).

The report went on to say that education has two great values, both essential for American progress:

> From the standpoint of the individual, it equips his perceptions for greater satisfaction in the pursuit of the world's biggest business—which is the business of living. And from the standpoint of public investment, it has the responsibility of serving an expanding economy by progressively upgrading the productive skills and management aptitudes of the American people. Both of these functions are of vital concern to American business, because they are integral with our country's welfare. (50:3)

Other business men who express the same sentiments are Johnston (27), David (13), and Morgan (34).

These comments of business are essentially reiterated by Clark (8), Conant (9), Smith (47), Ter Keurst (49), and Younkman (57).

Boushall (5) in a more penetrating analysis of this problem proposed an "educational use tax" on employers in business and industry. His argument was that better education raised the standard of living and made better business, and thus enabled business to pay for education.

Givens (19), while recognizing the value of education for economic well-being, indicated that since 1929 school cost has increased less than income. Schools received 2.8 per cent of the national income in 1929 and only 1.5 per cent in 1943; or, in terms of taxes, in 1929 schools received 23 per cent, while in 1943 they received only 8 per cent.

Bagley (3) argued that education has been loath to use creation of wealth as an argument for more adequate recognition and support. Instead, it has catered to the conception of education as philanthropy by emphasizing the need for giving equal educational opportunity for all. This, he believed, does not go far enough because it neglects the main issue. The potential service of education "is of the very essence of civilization and progress" (3:396).

Finally, Roberts (44) argued that teachers believe they are professional persons but that they are not, either by legal definition or by material rewards. Legally, a profession consists of a group of persons who govern themselves from within the group, such as doctors and lawyers. Teachers do not so govern themselves. Teachers, he adds, must control their own calling from within, as genuine professional persons, if they are to get the monetary rewards they deserve.

Effects of Schooling on Measured Ability. Few studies discussed the relation between environmental deprivation and school attainment, although Asher (1) and Wheeler (54) gave the matter a passing thought. Many studies, however, discussed the relation between schooling and intelligence test scores. Wheeler (54) found Tennessee mountain children, near normal at age 6, showed a gradual decrease with age, so that at age 15 the median I.Q. was 69 on the Illinois test and 74 on the Detroit test. Similar findings were reported by Ludeman and McAnelly (31), Asher (1), Sherman and Key (45), Edwards and Jones (16), McCandless (32), Skeels and Fillmore (46), and Dawson (14). The whole question was also discussed at length in the Thirty-Ninth Yearbook of the National Society for the Study of Education (39).

In contrast to the preceding studies, Lamson (30) found that children exposed to a "rich, vital school curriculum" did not show significant gains in intelligence test scores. Perhaps his results might have been different if the study had been controlled more carefully and extended over a longer time.

Evaluations of Teaching and Learning. The scales and suggestions pertinent to the present study were given by Henry (23), Myers (35), Hamalainen (21), Mort and Cornell (37), Herrick (24), Wrightstone (53), and the North Central Association (10, 11).

Studies by Spaulding (45) and Watkins (50) showed the superior achievement of pupils in modern schools compared with that of the previous generation. Hughes and Lancelot (25) studied data from the 48 states and from many nations in attempting to evaluate the efficacy of the respective school systems. A group of studies under the guidance of Barr attempted to investigate the relationship between ratings of teaching efficiency and certain objective measures. Typical of these studies is that by Jones (28) who concluded that the criteria

of teaching efficiency were not significantly related. Pupil gain measured in relation to teaching ability was not emphasized in supervisors' ratings.

Summary of Literature. A review of the studies summarized indicates no direct attack on the relation between school adequacy and pupil achievement. Many studies somewhat indirectly related to the problem were published. Business men and educators are agreed on economic and other values of education. Perhaps the most frequently mentioned aid to education was equalization, but investigators agreed it should come without bringing in undesirable outside controls. It was also indicated that people from regions of poorer school support tend to fall behind when competing with those from better school support, whether the measures were Army qualifying tests or group intelligence tests.

Possibly reasons for the few studies of the relations between school adequacy and pupil achievement may be found in the difficulties of measuring adequacy and in the lack of sufficient variation among schools in most communities.

Groups Studied and Measuring Devices Used

Groups Studied. The groups studied in the present report consist of those rural pupils whose districts transport them to the University High School for their four years of high school work. In this group there are pupils from the Poplar Grove, Fleener, Hillside, Sanders, Snoddy, Phillips, Lampkins (discontinued after 1946), Knight Ridge, Handy, and Finley schools. Since Percifield and the public local urban elementary schools, McCalla and Elm Heights, transfer their pupils at the end of the sixth grade, pupils from these schools were not used in this study.

Classes included in the present investigation are those entering in the fall of 1946 and 1947. Tests were given to these rural and urban people shortly before they graduated from the eighth grade. Ratings of school adequacy were also made at about the same time.

Tests Used. Tests administered for this study were the California Test of Mental Maturity, the Otis Self-Administering Group Intelligence Test, the Cooperative English Test C-1, and the Cooperative Arithmetic Test. The California Test of Mental Maturity yielded verbal and non-verbal scores; the Cooperative English Test C-1 yielded scores in vocabulary, speed, and level of comprehension in reading; the Cooperative Arithmetic Test yielded scores in skills, facts, applications, and appreciation. Raw scores were transformed into percentile ranks, and all comparisons were made in terms of percentile ranks.

School Adequacy Ratings. Two ratings of school adequacy were made: (1) that dealing with the physical aspects of school environment, and (2) that dealing with the teaching and learning atmosphere.

The scale for rating the school environment consisted of the following categories:

A. School Plant—site, building, furniture, equipment, heating, illumination, provisions for bodily needs and comforts, provisions for safety of persons and property, appearance, adequacy of space, playground facilities, and maintenance.

B. Community Resources—occupational and educational level of adults, educational agencies (libraries, forums, musical and dramatic performances, etc.), recreational resources, sanitary and health status of the community, interest and attitude towards school.

C. Library—suitable number of books and periodicals appropriate to level of pupil development, provisions for keeping the materials timely, suitable housing, accessibility to pupils.

D. Financial Support—resources, effort made to support education, cost per pupil in relation to other districts, teacher salaries, adequate materials and supplies, teacher-pupil ratio, special services (health, etc.).

Ratings of 0 to 5 were independently assigned by each of the two raters to each characteristic mentioned above. Ratings for each of the four parts, A, B, C, D, were totaled separately. Each part was then weighted so that it would contribute the same relative amount to the total score.

The scale for rating teaching and learning atmosphere was divided into 20 points:

General learning atmosphere of the school
Rating of learning activities
Relationship between pupils and teacher
Flexibility of plans
Nature of class participation
Pupils' use of time
Nature of incentives for learning
Use of instructional materials
Use of reference materials
Use of visual and auditory materials
Classroom library
First-hand experiences exclusive of trips
Sequential development of learning experiences
Integration of understandings
Use of community resources in the instructional program
Provisions for individual differences
Individualization within the group and other enterprises
Variation of individual procedures and standards in the interpretation of work
Giving direction to balanced development of children
Pupil responsibility for materials and care of room

Each of these 20 items was rated independently by two raters on a scale ranging from 0 to 5 points. The lower score indicated the poorer practice.

The correlation between the two raters on ratings of school environment was 0.84, and that between them on learning atmosphere was 0.79. The final rating assigned to a school was an average of the ratings given by each rater.

Results

Scores on ratings of the school environment ranged from 11 to 79 points, while those on ratings of the learning situation ranged from 27 to 85 points. It should be added that schools at the lower end of the distribution—those with scores below 45—leave a good deal to be desired. Those with scores of 70 or over gave an over-all impression, to the raters, of being rather adequate. In making the ratings, whenever there was doubt, the raters always chose the lower rating. This may account for the fact that the highest scores did not more closely approach 100.

Table I probably represents the most important findings of this exploratory study. In order to discourage invidious comparisons, the urban school scores and the specific school adequacy ratings are omitted. In this table the California Test of Mental Maturity and Otis Self-Administering Group Intelligence Test results are expressed in terms of I.Q. All other test scores are expressed in terms of percentile ranks.

In terms of the intelligence test scores, schools 2, 3, 5, 6, 7, 8, and 10 are sending out transfer students who perform at about the average level. Schools 1, 4, and 9 seem to be somewhat below average in this respect.

With reference to Iowa Silent Reading Test scores, only schools 2 and 3 perform at the average level. The others, especially schools 4, 6, 8, and 9, are seriously deficient.

TABLE I. MEAN TEST SCORES OF THE TEN RURAL SCHOOLS

Test	Test Scores in Each School									
	1	2	3	4	5	6	7	8	9	10
California Test of Mental Maturity										
Non-Language	87	115	106	74	96	95	101	96	80	92
Language	88	104	96	91	92	92	90	94	85	101
Total score	88	107	101	86	94	94	95	96	84	100
Otis Self-Administering Group Intelligence Test	86	102	96	86	97	96	102	99	86	98
Iowa Silent Reading Test	23	55	45	5	20	6	16	7	5	15
Cooperative English Test C-1										
Vocabulary	26	60	9	9	16	10	26	5	11	26
Speed	30	58	24	9	29	4	12	5	9	5
Level of Comprehension	21	26	24	8	45	6	13	7	7	8
Total score	25	46	16	8	31	12	14	5	6	7
Cooperative Arithmetic Test										
Skills	24	33	22	11	42	41	8	35	10	53
Facts	23	51	12	9	43	25	31	21	11	26
Applications	23	21	38	3	46	12	9	14	14	21
Appreciation	25	31	13	13	27	34	22	28	7	29
Total score	23	35	21	5	39	24	9	20	12	33

In terms of the Cooperative English Test C-1, only the pupils from school 5 a e anywhere near the average level of performance in reading comprehension!

The performance of the entire rural group tends to be relatively better on the Cooperative Arithmetic Test than on the Cooperative English Test. This disparity is especially noticeable in schools 6, 8, and 10.

In summary, it may be said that the rural group is much closer to the average in total group performance on the intelligence test than it is on the reading and arithmetic tests.

TABLE II. SUMMARY OF CORRELATIONS FOUND BETWEEN RATINGS OF SCHOOL ADEQUACY AND MEAN TEST SCORES ACHIEVED BY TRANSFER STUDENTS ENTERING UNIVERSITY HIGH SCHOOL

Tests	Ratings of School Adequacy	
	School Environment	Learning Atmosphere
California Test of Mental Maturity		
Verbal score	.51	.42
Non-verbal score	.28	.31
Total score	.39	.34
Otis Self-Administering Group Intelligence Test score	.44	.37
Iowa Silent Reading Test score	.36	.32
Cooperative English Test C-1		
Vocabulary score	.41	.33
Speed score	.15	.09
Level of comprehension score	.23	.37
Total score	.32	.26
Cooperative Arithmetic Test		
Skills score	.24	.29
Facts score	.36	.31
Applications score	.17	.20
Appreciation score	.04	.12
Total score	.21	.25

Table II considers the relationships between the ratings of school adequacy and the scores made by the rural transfer students on the various tests. In computing the entries for this table, rank difference rather than product-moment co relation was used because the data, by virtue of the ratings in the case of school adequacy and averaging in the case of school test score, take on the characteristics of an ordinal rather than a cardinal series.

Ratings of school environment seem to correlate slightly higher with the test scores than do ratings of learning atmosphere, but the difference obviously is too small to be significant.

Correlations between adequacy ratings and intelligence test scores seem to be highest, while those between adequacy ratings and arithmetic test scores seem to be least.

Perhaps the most significant finding is that, in every instance, except one, the correlations are positive and, taken as a group, are sig-

nificantly different from zero. This would indicate that the criteria of school adequacy do bear a very definite relation to performance of pupils on certain tests.

Conclusions

It should be emphasized again that, because of the complexity of the problem and the lack of previous studies in this area, the present study was undertaken more in the nature of a survey of the field than as a comprehensive investigation to trace out the various interrelationships involved. Despite the limitations of this survey, the results indicate that there was a definite relationship between the ratings of school adequacy and the performance of pupils on certain objective tests.

The question, "Do good schools pay?" is answered by an emphatic "Yes."

Like most investigations, this one has raised more questions than it has been able to answer—questions as to the determination of the validity and rehability of school adequacy ratings and questions as to the relation of school adequacy not only to formal subject matter areas but also to the mental processes and the other desirable outcomes of education. Since it appears that individuals from a poor school environment are handicapped in academic competition, it is pertinent to ask how much, if any, of this handicap can be overcome when they are exposed to a richer, fuller school environment. These questions are being studied in an investigation whose scope is extended along the lines indicated by this one, but the data will not all be in until a number of these classes have been followed throughout their high school careers by a longitudinal approach.

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Visualization and Junior High School Mathematics

by

A. PRYCE NOE

Instructor and Critic Teacher in Mathematics, Indiana University

PERHAPS no single subject of elementary instruction has suffered so much from lack of scholarship on the part of those who teach it as mathematics. Arithmetic is universally taught in schools, but almost invariably as the art of mechanical computation only. The true significance and the symbolism of the processes employed are concealed from the pupil and teacher alike.[1]

This paragraph, which actually appeared in print about forty-seven years ago, might easily be expected to appear in a modern mathematics text. Modern philosophy in teaching mathematics still stresses the need for emphasis on practical usage. Of course the logical question arises: What is practical mathematics? For purposes of discussion here, we will assume that practical mathematics is mathematics that can be visualized.

Visualization is the art or power of forming visual images of objects not present to the eye. In modern psychology several things happen in the art of forming and fixing a clear mental image of the form of an object. Whenever a person performs psychological activities, he is interacting with something. He does not see unless he sees an object, or hear unless he hears some kind of sound. He does not "think" unless he can recall some past experience. In modern psychological theory, thinking involves more than isolated, specific action patterns. It includes the whole organism. A student is told to "think" through a problem in mathematics. This process of thinking involves quite a detail of reactions. The student must have had experience with that which he is supposed to think. To recall is to have a mental image of that which is to be recalled, or the reproduction of former knowledge or experience that may not be identified or recognized as something previously known or experienced. When the student is told to "think" through a problem, the first reaction must be that of reading the printed page. The eyes are brought into play. Of course it is a fact that, if the student cannot read the printed page, there cannot be a favorable reaction to the solution of the problem. But if the student can read the printed page and the problem is in the realm of his experience, then there is a possibility of a solution.

Experience is the acquisition of knowledge, attitudes, or skills through one's own perception and participation; or, we could say educative experience is any interaction of the individual with his environment which brings about desirable changes in him in the direction of higher development. The desirability of such changes are determined by his needs and by the social and educational standards of the culture to which he belongs. To be even moderately literate there are certain skills that each individual must have at his command.

[1] Smith, D. E., *The Teaching of Elementary Mathematics*, New York, 1900 (reprint 25), p. 9.

He must first of all be able to read, write, and carry on certain arithmetical work. The elementary school concerns itself with such matters. However, as a pupil comes to the junior high school mathematics classes, his society grows increasingly complex and technical, and the range of his necessary or highly desirable skills is broadened continually.

Now, as we know more about what is meant by realm of experience, let us further illustrate it by two problems taken from a junior high text:

> Problem 1. The daily circulation of a certain newspaper is 100,000 copies. Each copy contains 20 pages, whose dimensions are 18 inches and 24 inches. If all of these sheets were spread out edge to edge on a street 75 feet wide, how many miles of street would be covered.
>
> Problem 2. How many students at your school can get a drink at rest period? You will have to know several facts before you can answer this question. (1) How many fountains in your school? (2) How many students in your school? (3) What is average length of time to get a drink? (4) What is the length of the rest period? (5) How many fountains would you have to have if everyone wishes to get a drink?

Problem 1 is one of pure mathematical computation; nothing too realistic, very little that can be visualized; nothing the pupils have ever seen or ever will see. Their work will be purely mechanical, with no thought of how the processes are being used. Problem 2 is alive; something the pupils see every day. They see the crowds around the fountain. They know that if all want to drink, and they are at the end of the line, they are likely not to get a drink. The mathematical computation has a meaning, and a desire for correct results will be stimulated.

In the fall of 1945 the seventh and eighth grade classes of University School were chosen to try out an experiment in visualizing mathematics. The main purpose was to determine whether or not stress on visualization would produce better mathematical learning. The classes were sectioned; that is, the seventh grade class was divided into two sections: Section A, which was to be the experimental group; and Section B, which was to be the control group. The eighth grade class was divided in the same manner. For administrative purposes, the division was made in the office before school started.

Section A, the experimental group, was to be taught at all times in a manner that would cause a visualization of the subject material. No text was to be used but, as will be illustrated later, the problems were to grow from the experiences of the pupils themselves.

Section B, the control group, was to use a text and was to follow it as closely as possible. The text was to form the basis for all discussion, and the procedure followed in teaching was the procedure suggested by the text. In teaching the basic geometric construction, this group used the text and was taught these conceptions as suggested by the text and at the time they came in the text.

Geometric principles were to be taught to Section A in a wholly different manner. A football field was selected to create an interest

in teaching the geometric principles that were desired. At the beginning, this question was asked: "How long is a football field?" The students were then handed a mimeographed slip of paper and asked to check the correct answer.

Table I shows the results of such estimates over a three-year period of time.

TABLE I. STUDENT ESTIMATES OF THE LENGTH OF A FOOTBALL FIELD

Estimate	Number of Students
10 feet	1
40 feet	10
50 feet	2
100 feet	10
200 feet	10
500 feet	41
50 yards	27
100 yards	76
175 yards	8
200 yards	8

Although they know and talk football, apparently the students do not have a very good conception of distance.

Before going to the football field, each student was given a foot ruler and a yardstick. First the foot ruler was compared to a yardstick. After that, the unit of measure talked about and used at the field was yards. The first lesson on approximation was given here. Approximate computation is calculation that involves the use of approximate numbers, or the application of methods of approximation to the exact numbers. An approximate number is a number that records the result of a measurement or series of measurements, derived as the result of a finite number of steps in a process that may demand an infinite number of steps, or results from applying the fundamental operations of arithmetic to any such numbers.

In the scope of this paper it is impossible to go into full detail as to how each geometric construction was taught, but when the class was completed, each student had a practical and visual concept of the basic geometric constructions. The following were taught in both classes—in the field to Section A, and from the text to Section B:

1. Erect perpendicular bisector to a given line segment. (2 in.)
2. Erect perpendicular to a line at a given point on the line.
3. Drop perpendicular from a point to a line.
4. Copy an angle. (60°)
5. Bisect an angle. (70°)
6. Construct a line parallel to a given line through a given point.
7. Construct a square. (S=2 in.)
8. Construct a parallelogram. (Given base, 3 in.; altitude, 1½ in.; and base angle, 40°)
9. Construct a rectangle.
10. Construct a trapezoid. (Given lower base, 2½ in.; upper base, 1½ in.; altitude, 1 in.; and base angle, 60°)
11. Construct a triangle, given its three sides. (3 in., 2½ in., 1½ in.)

12. Construct a triangle, given two sides and included angle. (2 in., 1½ in., 50°)
13. Construct a triangle, given two angles and included side. (40°, 50°, 2½ in.)
14. Construct a circle with given radius. (1 in.)
15. Construct a hexagon. (1 in. sides)
16. Construct a pentagon. (72°)

To teach the circle and all its concepts, the experimental group was taken to the basketball floor.

This group was instructed in the use of the ruler, compasses, and protractor by constructing a scale drawing of a football field. The group was then taken into practical measurements, because the basic concepts were taught in measuring the football field. No definite time was taken to teach accuracy and approximations, but these were emphasized as they come up in class discussion. Each student was requested further to bring to class some problem that confronted him at home, school, or any other place. The specific problems studied were those the students brought to class, and each student helped and made suggestions toward the solution of all the problems.

Some of the problems needed expert advice in a certain field, as will be explained in the two examples that follow. Specialists in these fields were more than willing to come to the class and explain the technique involved.

The first problem explained is one brought in by a seventh grade girl. She wished to know how much material it would take to put up new curtains and drapes in her room at home. She made a scale drawing of her room, and took measurements to the closest inch. The art department helped her make the drawing neat and accurate. She then reproduced the scale drawing on a slide. The visual aids department cooperated with her and helped her make this slide. After the slide was finished, she showed it to the entire class, and made a full explanation, giving the measurements. She explained what she wanted to do. The whole class helped her do her figuring. Of course, there were variations in the computations, and a few mistakes, but these were corrected. She then went to the department store and brought back to class samples of materials available. She obtained the price per yard, and the width of the material. (If the teacher had been wise, he would have contacted the department store and explained to the manager the project, and obtained a discount on the material. This would have afforded an opportunity for study of the basic principles of discount.) After she had figured the cost of the material, the project was taken to the home economics department. She then made the curtains as a project in home economics. After she got them made, the English department encouraged her to write about this project as a theme in English. In this one problem in mathematics, five departments—art, visual aids, home economics, English, and mathematics—were involved.

If we study this problem briefly in light of the visualization of mathematics, we find that every process followed by this girl was within her experience, and she could see every detail of the problem.

She did not read about another girl who had a room and wanted to put up curtains. She was the girl; she could see her own room; she could close her eyes and see the whole detail. She had to explain it so that most of the class could have a mental picture or imagine themselves in her room, and could visualize what she wanted done to her room.

In mathematics class, if all work is within the experience of the students, the students become interested and the mathematics computation involved becomes a pleasure instead of a dreadful process.

The following problem was one of the most complicated problems that was solved in the eighth grade. An eighth grade boy wished to build a small building on the back of his father's lot—a small building that he could use as a shop and a place to keep his bicycle and motor scooter.

The industrial arts teacher was called in on this problem before the project was approved. It was agreed that this problem should be supervised by the industrial arts department, but that the mathematics involved must be done and approved by the mathematics class. This involved all the geometric principles, drafting, laying out of plans, figuring of board feet and areas, and finally, figuring of costs. The labor union representative was invited to the class, and he explained labor unions and what supervision they had on building in the community. Painting problems, which are not necessarily a part of junior high school mathematics, were involved. However, painting and painting costs were taught here very nicely, because the entire class visited the building and really saw or visualized what was needed. Thus they learned a lesson in painting that they would always remember. The little building was real, and the above examples will show how problems that are real to the student, problems they can touch, see, hear, smell, or taste, which call for mental imagery, become real experiences in the lives of the student.

Mathematics of this kind is not mechanical, it is real; and the computation of numbers becomes a real live thing. Each child is encouraged to present a problem. Some are simple, some complex, but the class helps to some extent on all problems. Yet the main work is done by the individual who has the practical problem to solve.

In simple addition, students were taught to visualize numbers rather than to use a mechanical process. Here is a true example of how one eighth grader explained an adding problem. It was a purely mechanical process and could be carried on without a full realization of what numbers could mean, with scarcely any visualization on the part of the student.

The class was told to add 848 and 186.

"I must set them so that the two first figures stand one over the other, and the others over the numbers of the same place, setting always the greatest number highest as 848. Then I must add 6 and 8

186

which is 14. I cannot write 14 down, but I will write the 4 down as 848, keeping the 1 in mind.

186

4

"Next I come to the second column and must add 4 and 8 which is 12. Now I had to carry a 1, so that would be 13. I cannot write 13 so I write the 3 down thus, 848, keeping in mind the 1.

186
34

"Now I come to the third figure, so I must add 8 and 1 and get 9. The 1 I carry makes 10; so I write down the 10, thus, 848, so when I add 848 and 186 I get 1,034."

186
1,034

Now let us look at the training that this student should have had and see how easy it would have been for him to read the answer 1,034 and have everyone see that it was correct. An eighth grade pupil should be able to see the combination of unit numbers. He should see, for example, that 7 and 8 must add to 15. He does not need to count; he just knows the sum is 15. Now let's take 87 and 46 to add. He knows 80 and 40 would be 120 and that 7 and 6 would be 13; so he just reads 133 as his answer. Another way to look at it is this: The 8 and 4 are 12, but the 7 and 6 must go to the tens number; so the 12 would be 13 and the last number must be 3. So, starting at the left, he would read 100; then, at a glance at the 7 and 6, he would know the next figure would be 30, and then adding the 3, his answer would be 133.

Let us take the problem in which the student was taught to "carry," 848 plus 186. The numbers need not be put under each other at all. The student will glance at the 800 and 100 and know his answer must be in the hundreds; in fact, that it must be not less than 900. Then he glances at the 40 and 80 and knows the sum would be in the hundreds, so his 900 becomes 1,000. While saying 1,000, he will glance at his 8 and 6 and know the answer is in the tens. He already knows that 40 and 80 makes 120, so he says 30, and, since he already knows the combination of 8 and 6, he says four. Now, in a breath and three glances, but not hurriedly, he reads 1,034. He just knows his answer will have to be correct when he reads it. His answer at first may be somewhat slow but, as he sees the numbers as wholes, the answers will be more swift and accurate.

There is nothing mechanical about it. There are no rules to follow, because it is just that—no more—no less.

Let us look at the process of subtracting in the same manner. It isn't anything new, it is a small process which will cause the student to become more number conscious and have him visualize numbers that are given him.

Take this subtraction problem, 9,476.
3,919

This time, again, the student reads the answer as he writes it down, from left to right. Now if the problem was 3,000 from 9,000 he would know the answer would be 6,000, but when he glances at the 900 from 400 he knows the 9,000 will have to be 8,000 so he reads 5,000. Then, when taking 900 from 1,400 he glances at the 1 from 7 and knows he can take 1 from 7, so he says 500. Now 10 from 70 would be 60, but a glance at the 9

from 6 shows him it is 10 from 60 instead, so he says 50. Now 9 from 16 is seven, so he has read the answer 5,557 as his answer.

After a little practice on such problems as these with pencil and paper, the student can read and write the answers as quickly as he can see the problem. Any length problem can be done easily and quickly. Oral drill should follow practice with pencil and paper. Here psychology must be brought into play. Numbers above the memory span should not be given. It is better not to give numbers over the hundreds because this would call for a memory span of more than six numbers. Start with problems like: add 87 and 42, or 369 and 256.

The above discourse illustrates the general methods and procedures used in an attempt to get the control group to visualize the mathematical processes.

Progress in arithmetic was checked by administering both the Stanford[2] and Progressive[3] Arithmetic Tests to both the experimental and the control groups. Both tests were administered at the beginning of the experimental period, and different forms of both tests were administered at the end of the experimental period. Grade equivalent gains were averaged for the two tests.

Results

Table II is a summary of the gains in tested arithmetic achievement made by individuals in both the experimental and the control groups. The gains were measured in terms of tenths of a year in grade equivalent, and for tabulation purposes were grouped into step intervals of .3 year.

It takes only a superficial examination of Table II to determine the relative superiority in gains of the experimental group compared to those of the control group. Only about 7 per cent of the control group made as much as 3 years gain in grade equivalent, while about half of the experimental group achieved this objective. Only about 8 per cent of the experimental group failed to gain at least 2 years, while about two thirds of the gains of the control group fell within this range.

The mean gain for the experimental group was 3.5 years, while that for the control group was 1.6 years, or less than half that of the experimental group. It is true, however, that both groups gained more than 1.0 year, which would be the expected average gain during the experimental period. This may be due, in the case of both groups, to factors such as low achievement status at the beginning of the experimental period and subsequent extra efforts on the part of the teacher to remedy this situation.

The lack of rigid statistical control and analysis makes it unwise to attempt broad generalization concerning the relative effectiveness of the "visualizing" procedure in teaching junior high school mathematics. However, these results certainly argue in favor of such ef-

[2] Kelley, Truman L.; Ruch, Giles M.; and Terman, Lewis M. *Stanford Arithmetic Tests.* World Book Company, 1940.

[3] Tiegs, Ernest W., and Clark, Willis W. *Progressive Arithmetic Tests.* California Test Bureau, 1942.

TABLE II. SUMMARY OF GRADE-EQUIVALENT GAINS IN TESTED ARITHMETIC MADE BY THE EXPERIMENTAL AND CONTROL GROUPS DURING THE EXPERIMENTAL PERIOD

G.E. Gains in Tenths of a Year	Experimental Group		Control Group	
	Number	Per Cent	Number	Per Cent
6.8—7.0	1	1	0	0
6.5—6.7	0	0	0	0
6.2—6.4	2	2	1	1
5.9—6.1	1	1	0	0
5.6—5.8	0	0	0	0
5.3—5.5	1	1	2	2
5.0—5.2	2	2	0	0
4.7—4.9	3	3	1	1
4.4—4.6	3	3	0	0
4.1—4.3	8	9	0	0
3.8—4.0	4	5	2	2
3.5—3.7	8	9	1	1
3.2—3.4	12	14	0	0
2.9—3.1	16	18	2	2
2.6—2.8	8	9	3	3
2.3—2.5	8	9	7	8
2.0—2.2	2	2	9	10
1.7—1.9	3	3	15	17
1.4—1.6	2	2	14	16
1.1—1.3	2	2	18	20
.8—1.0	1	1	12	13
.5— .7	0	0	2	2

fectiveness, so much so, in fact, that it would appear wise to suggest further research along this same line. This research probably should be aimed at using more nearly normal groups, and should go deeper into statistical analysis.

The Use of IBM Techniques in Program Making and Class Scheduling

by

FRANK L. TEMPLETON
Assistant Principal, Bloomington High School

SECONDARY schools have gradually increased their curricular offerings in response to a felt need for a wider variety of courses to meet the needs of students with varying educational interests. The result has been that the secondary school administrator and his helpers have found schedule making more and more difficult and complicated. This article attempts to show how one secondary school has reduced the labor involved in program making and class scheduling and at the same time has made the process more accurate and satisfying.

In the past, Bloomington (Indiana) High School has used the types of program election routines prevalent in other Indiana cities—routines that are advocated in textbooks on school administration. According to these plans, after students complete program election cards the principal and his helpers face the tedious task of tabulating this information. Until the enrollment figures in each subject are complete, the principal cannot decide which classes are to be formed the following semester and which will not be offered due to small enrollments. Because these decisions cannot be made ahead of time, it is necessary that many changes in student schedules be made later, either as the result of the dropping of certain classes or of the shifting of courses to hours that cause conflicts in a student's schedule.

In an attempt to solve some of the problems arising in such a situation, the author suggested the use of International Business Machines (IBM) punch cards to facilitate the work of the school administrator. Bloomington High School is fortunate in that it is located in the same city as Indiana University and that the University operates a group of the International Business Machines. It was therefore possible to discuss with the members of the School of Education and of the School of Business the problems involved in adapting the program election and schedule making process to IBM punch card techniques. Members of both schools urged that the plan be developed and tested, and they also volunteered their professional and technical assistance.

After extended study and conference, it was decided that the blank IBM card (No. 507536) be purchased, and that it be overprinted by the Bloomington High School printing department so that it contained all the items which might be needed. (See Figure 1.) Care was taken to locate these items on the cards in such a way that each would be visible to the operator of the punching machine at the time the card was punched on the IBM machine.

The front side of the card asks for much general data, including the student's sex and race, whether he was a city or rural student,

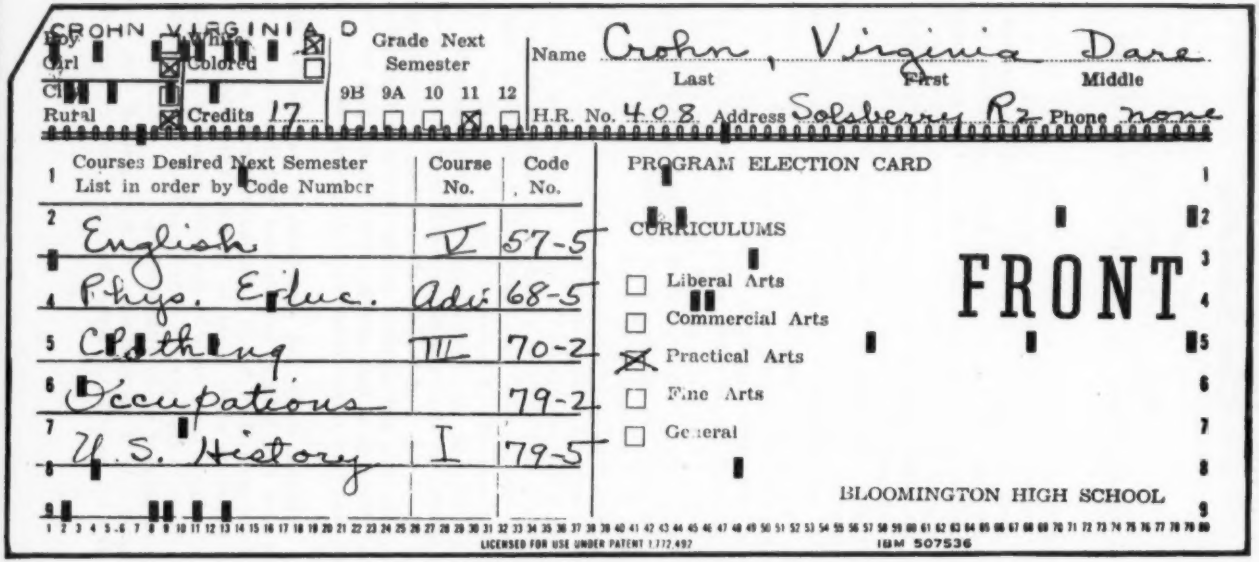

Fig. 1. Front side of an IBM card, filled out and punched.

the number of school credits he hopes to have at the end of the current semester, his anticipated grade level next semester, his curriculum, and his name, home-room number, home address, and telephone number. In items in which there is a choice of answers listed the student is to place an X in the box opposite the one which applies to him. The left half of this side of the card provides six horizontal spaces in which the student is to write the names of the courses desired next semester, together with the identifying course numbers and the punch card code numbers.

The principal sets aside a certain day during the semester when the students are to fill out these program election cards. About two weeks before that date, the home-room teachers are supplied with mimeographed sheets entitled "Program Election Choices." (See Figure 2.) Each student who plans to be in grade 9, 10, 11, or 12 the

PROGRAM ELECTION CHOICES

Student's Name Casterday, Henry C. Home Room 909 Date Apr. 20, 1947

BUSINESS EDUCATION	M	——
Bus. Arith. I		50-1
II		50-2
Everyday Bus.		51-1
Intro. to Bus.		51-2
Geography I		52-1
Typing I		53-1
II		53-2
III		53-3
Shorthand I		54-1
II		54-2
III		54-3
IV		54-4
Bookkeeping I		55-1
II		55-2
III		55-3
IV		55-4
Off. Prac. I		56-1
II		56-2
Bus. Problems I		56-3
Jr. Bis. Educ.		56-4
Retail Selling I		56-5
ENGLISH - - - - - - -	+	- -
English I		57-1
II		57-2
III		57-3
IV		57-4
V	X	57-5
VI		57-6
Adv. Gr. & Comp.		57-7
Modern Literature		57-8
Speech Fund.		58-1
Radio Speech I		58-2
II		58-3
Dramatics I		58-4
II		58-5
Journalism		59-1
FINE ARTS - - - - - -	+	-
Mixed Chorus		60-1
Girls' Chorus		60-2
Boys' Chorus		60-3
Music Theory I		60-4
Music Apprec.		60-5
Piano Class		60-6
Band		61-1
Orchestra		62-1
Art I		63-1

FINE ARTS (CON'T)	M	——
Art II		63-2
Adv.		63-3
FOREIGN LANGUAGE - -	-	- -
Latin I		64-1
II		64-2
III		64-3
Adv.		64-5
French I		65-1
III		65-3
Adv.		65-5
Spanish I		66-1
III		66-3
German I		66-6
III		66-8
HEALTH & SAFETY - -	-	- -
Health & Safety		67-1
PHYSICAL EDUCATION -	+	- -
Phys. Educ. I		68-1
II		68-2
III		68-3
IV		68-4
Adv.	X	68-5
HOME ECONOMICS - - -	+	- -
Foods I		69-1
II		69-2
IB		69-3
Clothing I		70-1
II		70-2
III		70-3
IV		70-4
Home Nursing		70-5
Cafeteria		70-6
INDUSTRIAL ARTS - -	-	- -
Woodwork I		71-1
II		71-2
Adv.		71-3
Voc. (3 per.)		71-4
Machine Shop I		72-1
II	X	72-2
Adv.		72-3
Voc. (3 per.)		72-4

IND. ARTS (CON'T)	M	——
Mechanical Dr. I		72-5
II		72-6
Adv.		72-7
Printing I		73-1
II		73-2
Adv.		73-3
Voc. (3 per.)		73-4
AGRICULTURE (VOC) - - -	-	- - -
Agriculture I		74-1
III	X	74-3
Adv.		74-5
LIBRARY TRAINING - - -	-	- - -
Library Training		75-1
MATHEMATICS - - - - -	-	- - -
Gen. Math. I		76-1
II		76-2
Algebra I		76-3
II		76-4
III		76-5
IV		76-6
Geometry I		77-1
II		77-2
III		77-3
SCIENCE - - - - - - - -	-	- - -
Biology I		78-1
Botany I		78-2
Physics I		78-3
Chemistry I		78-4
Aeronautics I		78-5
Radio I		78-6
SOCIAL STUDIES - - - -	-	- - -
Community Living		79-1
Occupations		79-2
World History I		79-3
II		79-4
U. S. History I	X	79-5
II		79-6
Government I		79-7
II		79-8
Bible Study I		BS-1

Fig. 2. A program election choices sheet marked by the student to indicate the subjects he hopes to take the following semester.

following semester is given one of these work sheets. In addition to the space for the student's name, his home-room number, and the date, the program election choices sheet lists, in departmental groups, all subjects which the school might offer the following semester. At the right of each subject on the card is the IBM punch card code number assigned to that subject.

Coding was worked out according to the plan given in Table I.

TABLE I. IBM PUNCH CARD COLUMN NUMBERS AND THE INFORMATION REPRESENTED IN EACH OF THE COLUMNS

Column Numbers	Information Represented
1-30	Student's name; punched and typed in one operation
31-41	Not used
42	Sex (Boy, 42-1; girl, 42-2)
43	City or rural (City, 43-1; rural, 43-2)
44	Race (White, 44-1; negro, 44-2)
45	Grade next semester (Grade 9B, 45-1; 9A, 45-2; 10, 45-3; 11, 45-4; 12, 45-5)
46-48	Home-room number
49	Curriculum (Liberal arts, 49-1; commercial arts, 49-2; practical arts, 49-3; fine arts, 49-4; general, 49-5)
50-80	School subjects as listed on the sheet giving program election choices

As indicated in Table I, each of the school subjects was given a number between 50 and 80. English, for example, was assigned the number 57. Besides the column number, each course was also given a second number, which indicates the semester or grade of work being taken in that subject. Thus, English VI was given the code number 57-6. Care was taken to assign code numbers in such a way that it would be highly improbable that a student would select two courses with the same column number. This was watched particularly with respect to elective courses.

During the two weeks between the time the students fill out their program election choices sheets and the day when the program election cards are to be made out, the home-room teachers and the counselors use whatever time is available to discuss course plans with each student individually. It is during these conferences that the courses which the student expects to take the next semester are checked on his program election choices sheet.

On program election day, the home-room teacher gives a program election card to each student in her home-room. Instructions are given concerning the filling out of the blanks which ask for general information, and then the students are told to copy the courses and corresponding code numbers from their program election choices sheets, listing them on the card in consecutive order according to their code numbers. Before the end of the following school day, each home-room teacher

checks the program election cards of her group to see that all items have been completed and are accurate. Any necessary additions or revisions must be made on that day. All cards should be complete by the end of the day, when they are sent to the principal's office.

After this, the program election cards are ready to be punched by the IBM operators. Each card presents the possibility of using 80 columns, numbered in small figures along the base of the card, which are used as the subject field columns. Each of these columns also is provided with nine possible vertical punch spaces, known as "digits," which are indicated by the small numbers at either end of the card. Thus, the code number 57-6, for English VI, would be represented by a hole punched in column 57 opposite digit 6. An experienced operator can punch these cards completely at the rate of one in 1½ minutes or less.

When all cards have been punched, the IBM operator runs them through the sorter and counter. Since 31 numbers (from 50 through 80) represent the different subjects taught, it is possible to obtain a complete tabulation of the number of elections in each subject by running the cards through the sorter 31 times. As the cards are sorted into these subject fields, the machine also divides them into the courses under that subject field, according to the digit space punched out. Thus, the 57-1 (English I) students, 57-2 (English II) students, etc. may be counted separately.

Each run through the sorter is at the rate of about 1,000 cards each three minutes. If, in such courses as physical education, it seems desirable to have the boys and girls counted separately, the sorter can be set to divide the cards in this way also.

After the counting has been completed and the number of students choosing each course has been listed on a program election choices sheet, the principal is ready to study the tabulation sheet. With this information at hand, he can readily tell how many sections will

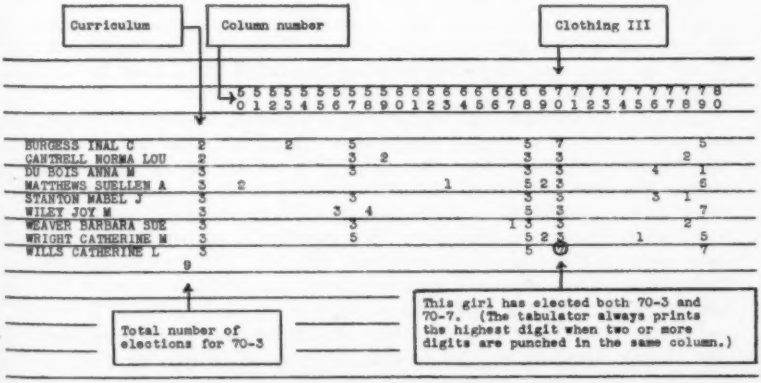
Curriculum
Column number
Clothing III
BURGESS INAL C
CANTRELL NORMA LOU
DU BOIS ANNA M
MATTHEWS SUELLEN A
STANTON MABEL J
WILEY JOY M
WEAVER BARBARA SUE
WRIGHT CATHERINE M
WILLS CATHERINE L
Total number of elections for 70-3
This girl has elected both 70-3 and 70-7. (The tabulator always prints the highest digit when two or more digits are punched in the same column.)

Fig. 3. A class sheet, as printed by the tabulator.

be required in courses in which there are many enrollments and which courses will have to be dropped because so few students have elected them.

The dropping of courses naturally creates a problem, in that students who have chosen a course that is not offered must elect some other course to replace it. The cards of students who have signed up for these subjects can be quickly sorted out by the sorting machine. The counselors then see these students individually, help revise their schedules, and make new cards to replace those which have been pulled out. When these changes have been made, a new and "final" tabulation is made, and the principal is ready to make up his tentative schedule of classes.

While the principal is developing his first draft of the schedule of classes, the program election cards are in the hands of the IBM operator, who again runs them through the sorter, this time at a more leisurely rate. With this operation of the machine, the cards for each course are put in alphabetical order.

Each alphabetized group of cards is then placed in a machine known as a tabulator. This machine is so set up that, as each card goes through it, a line of print appears on a sheet of paper, giving the data on that card. These lines are printed at the rate of about 80 lines a minute. They appear on a continuous sheet of paper, which has perforations dividing it into page sizes.

Any or all of the items punched on the card may be recorded on this sheet of paper. At Bloomington High School the only items used are the student's name, his curriculum, and all of his subject elections. (See Figure 3.) The listing for each course is started on a new page. The curriculum code number of each student is printed in a column to the right of his name. The subject election code numbers are written across the top of the right-hand side of the page, and are arranged consecutively, from 50 through 80 (the numbers assigned to the different subjects). The subject elections are indicated by digits printed under the code number headings representing subject elections. For example, on a line with the name of a student who has elected English VI, a 6 is printed in the column headed by the number 57. When the sheets are completed, they are assembled into a book for convenience and use.

After the principal has worked out a tentative schedule of classes, he must then find out what conflicts are involved. This information can be obtained from the class sheets. Conflicts in single section classes are most important, and should therefore be studied first. In checking for conflict in a single section class, the principal notes first which single section courses have been tentatively placed in the same class period. For example, if he finds that 58-2 (Radio Speech) and 78-5 (Aeronautics) have both been scheduled for the sixth period of the school day, he takes the IBM sheet which lists the class in Radio Speech and checks to see whether any of the students electing this course have also elected Aeronautics. To do this, he looks in column 78. If a 5 is found there, it means that some student has signed up for both courses, and has a conflict in his schedule.

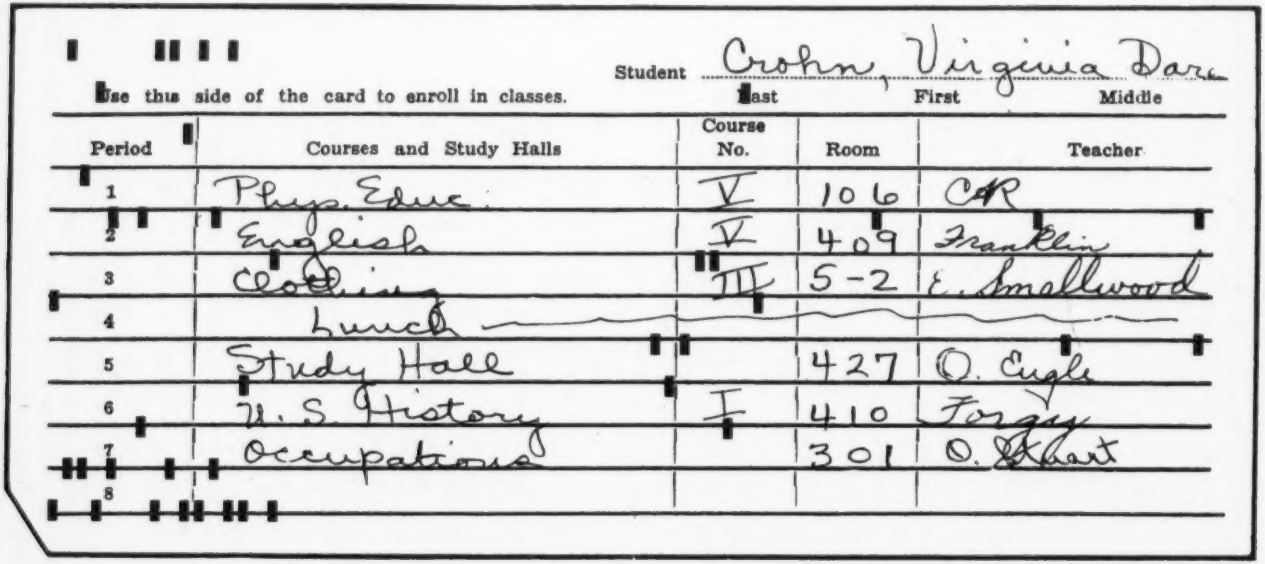
Use this side of the card to enroll in classes.
Student Crohn, Virginia Dare
Last First Middle
Period
Courses and Study Halls
Course No.
Room
Teacher
1 Phys. Educ. V 106 CAR
2 English IV 409 Franklin
3 Clothing III 5-2 E. Smallwood
4 Lunch
5 Study Hall 427 O. Eagle
6 U. S. History I 410 Forgy
7 Occupations 301 O. Ekhart
8

Fig. 4. Reverse side of an IBM card, filled out and punched.

When the principal has made a similar checking of all single section classes and found the conflicts, he tries to shift the classes within the daily schedule in such a way that almost every student will be able to take the subjects he desires. If conflicts still exist after shifts have been made, they can be easily located by the sorting machine. Conferences are then held with these students, and the necessary changes are made in their program elections. All of this is taken care of *before* the opening of the new semester.

The IBM operator can return the program election cards to the school in any desired order. At Bloomington High School, it has been found most helpful for the cards for the fall semester to be returned in alphabetical order but for those for the spring semester to be sorted into home-room groups, and alphabetized within each group.

At Bloomington High School the students enroll with the teachers of their choice on the first day of the new semester. Therefore, their individual class schedules are not prepared in advance. In many schools, however, the practice is for the administration to assign each student to his teacher and class period. In schools which handle their enrollment in this way, the subject election lists printed by the tabulating machine would be even more helpful than at Bloomington.

On the first day of the new semester the student is given his program election card and a copy of the schedule of classes. The reverse side of the program election card has been overprinted so that it can be used for enrollment in classes. (See Figure 4.) Under the supervision of the enrollment room teacher, he fills in a possible daily schedule for himself, including the courses on the front side of the card. Then, when enrollment time comes, he takes his card to each of the teachers involved and secures the signatures of those teachers. His enrollment is not complete until all necessary teachers' signatures are on the card and the card is turned in to his home-room teacher.

Any secondary school which has access to the use of the International Business Machines will find this plan of program making and class scheduling can, with a little adjusting, be made to fit its needs. Some of the operating cost can be saved if the school rents a hand-operated punching machine for a few days and school staff members or selected students punch the cards.

Since the name of the student cannot be punched on a hand-operated machine, all the program election cards can be turned in to the principal's office, alphabetized, and put in numerical order, beginning with the number 1,000. Then in the punching process, the identifying number can be punched instead of the name. This facilitates the sorting process, because it is easier to get the numbered cards back into order by means of the sorting machine, and when the cards are in numerical order they are also in alphabetical order. Then, when the cards are run through the tabulator, numbers instead of names are printed, but this does not complicate the locating of any particular card.

Large secondary schools will find this system especially helpful and quite adaptable, as their scheduling of classes is much more involved than that of small schools. Fortunately, it is the larger schools that have the advantage of being within range of IBM machines and may therefore have such services available to them.

Bulletins in the Field of Education, Indiana University

The Bulletin of the School of Education, Indiana University, was first published in 1924 and has appeared regularly since that time. Research studies of interest to educators, proceedings of conferences held, and bibliographies of educational materials have been the principal fields touched upon in these bulletins. A complete list of the bulletins may be obtained from the School of Education upon request. The studies included in the present volume and in the two volumes immediately preceding it in date are listed below. Unless otherwise noted, these may be obtained for 50 cents each from the Indiana University Bookstore, Bloomington, Indiana.

One Hundred Fifty Years of Arithmetic Textbooks. By Henry Lester Smith, Merrill T. Eaton, and Kathleen Dugdale. Vol. XXI, No. 1, 1945. 153 p.

Bibliography of School Buildings, Grounds, and Equipment, Part V. By Henry Lester Smith and Harold E. Moore. Vol. XXI, No. 2, 1945. 79 p.

School Library Personnel in Indiana. By Margaret I. Rufsvold. Vol. XXI, No. 3, 1945. 80 p.

Source Material Relating to the Development of Education in Indiana. By Velorus Martz and Henry Lester Smith. Vol. XXI, No. 4, 1945. 95 p.

Bibliography of School Buildings, Grounds, and Equipment, Part VI. By Henry Lester Smith and Harold E. Moore. Vol. XXI, No. 5, 1945. 73 p.

Analysis of the Proficiency in Silent Reading of 15,206 Sixth Grade Pupils in 648 Schools in Indiana. By Henry Lester Smith and Merrill T. Eaton. Vol. XXI, No. 6, 1945. 52 p.

Analysis of the Proficiency in Silent Reading of 11,424 Sophomore Pupils in 243 High Schools in Indiana. By Henry Lester Smith and Merrill T. Eaton. Vol. XXII, No. 1, 1946. 51 p.

Analysis of the Spelling Proficiency of 82,833 Pupils in Grades 2 to 8 in 3,547 Teaching Units of the City Schools of Indiana. By William H. Fox and Merrill T. Eaton. Vol. XXII, No. 2, 1946. 50 p.

Analytic Study of the Student Personnel of the School of Education, Indiana University, 1931-1942. By Henry Lester Smith and Oscar P. Rausch. Vol. XXII, No. 3, 1946. 31 p.

School Building Planning and Related Problems: Proceedings. Vol. XXII, No. 4, 1946. 83 p.

One Hundred Fifty Years of Grammar Textbooks. By Henry Lester Smith, Kathleen Dugdale, Beulah Faris Steele, and Robert Stewart McElhinney. Vol. XXII, Nos. 5 and 6, 1946. 199 p.

Spelling Proficiency in Township Schools in Indiana. By William H. Fox. Vol. XXIII, No. 1, 1947. 32 p.

The Language and Mental Development of Children. By Ruth G. Strickland. Vol. XXIII, No. 2, 1947. 31 p.

Testing Services Offered by the Division of Research and Field Services. By William H. Fox. Vol. XXIII, No. 3, 1947. 31 p.

Suggested Procedures for Securing Economical and Efficient Pupil Transportation. By Maurice E. Stapley. Vol. XXIII, No. 4, 1947. 22 p.

Planning School Buildings for Tomorrow's Educational Program: Proceedings. Vol. XXIII, No. 5, 1947. 61 p. $1.

Studies in Secondary Education. By Carl G. F. Franzén, Elvin S. Eyster, Nicholas A. Fattu, A. Pryce Noe, and Frank L. Templeton. Vol. XXIII, No. 6, 1947. 49 p.